

Coronal polarization of pseudostreamers and the solar polar field reversal

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ABSTRACT

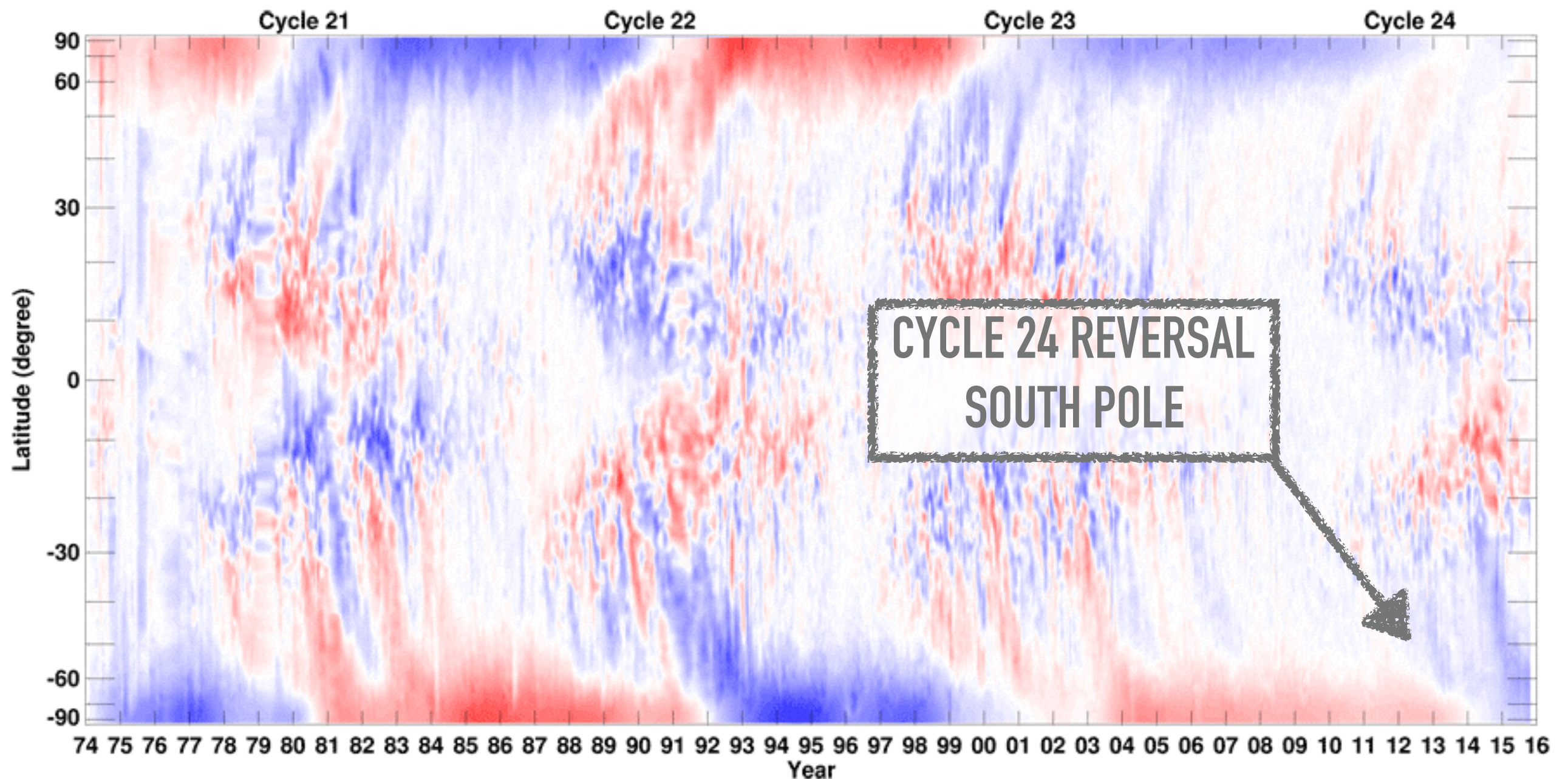
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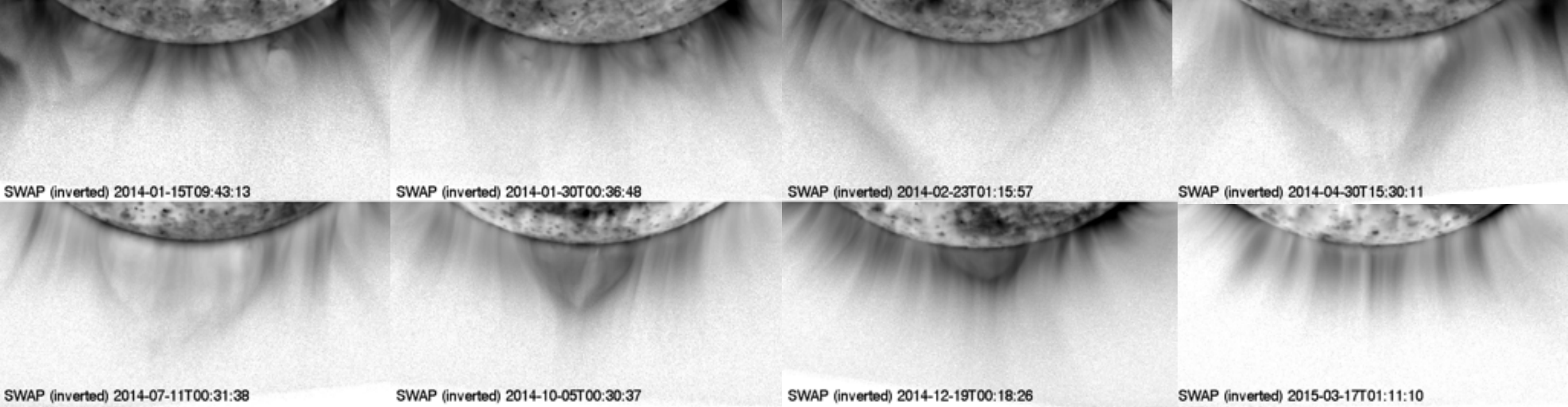
The reversal of the solar polar magnetic field is notoriously hard to pin down due to the extreme viewing angle of the pole. In Cycle 24, the southern polar field reversal can be pinpointed with high accuracy due to a large-scale pseudostreamer that formed over the pole and persisted for approximately a year. We tracked the size and shape of this structure with multiple observations and analysis techniques including PROBA2/SWAP EUV images, AIA EUV images, CoMP polarization data, and 3D tomographic reconstructions. We find that the heliospheric field reversed polarity in February 2014, whereas in the photosphere, the last vestiges of the previous polar field polarity remained until March 2015. We present here the evolution of the structure and describe its identification in the Fe XII 1074nm coronal emission line, sensitive to the Hanle effect in the corona.

POLAR FIELD REVERSAL

- Near solar maximum, the poles reverse polarity.

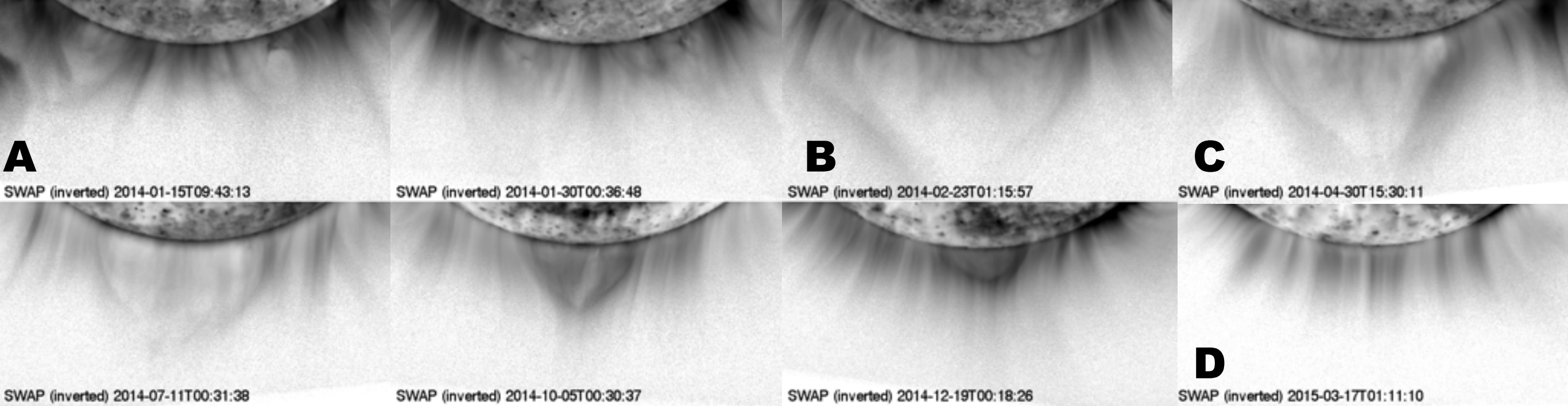


Red is positive magnetic flux, color scale is saturated at 15 G.

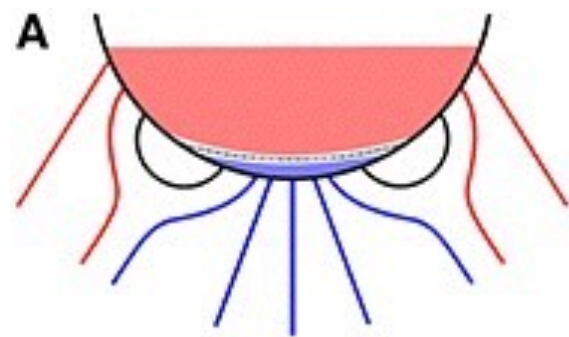


A pseudostreamer traces the polar reversal

Solar cycle 24, south pole, SWAP 174 Å images

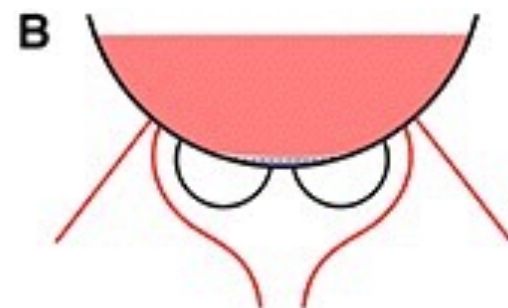


MAGNETIC STRUCTURE EVOLUTION



Coronal hole
with positive
polarity
surrounded by a
streamer.

Circumpolar
cavity (N. Karna
PhD talk)

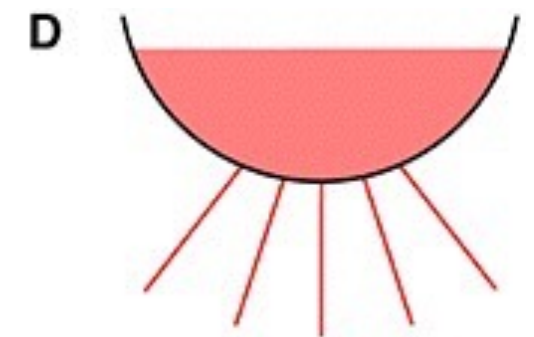


The neutral line
moves south. A
pseudostreamer
is born.

**The coronal
field reverses.**



The
pseudostreamer
shrinks.

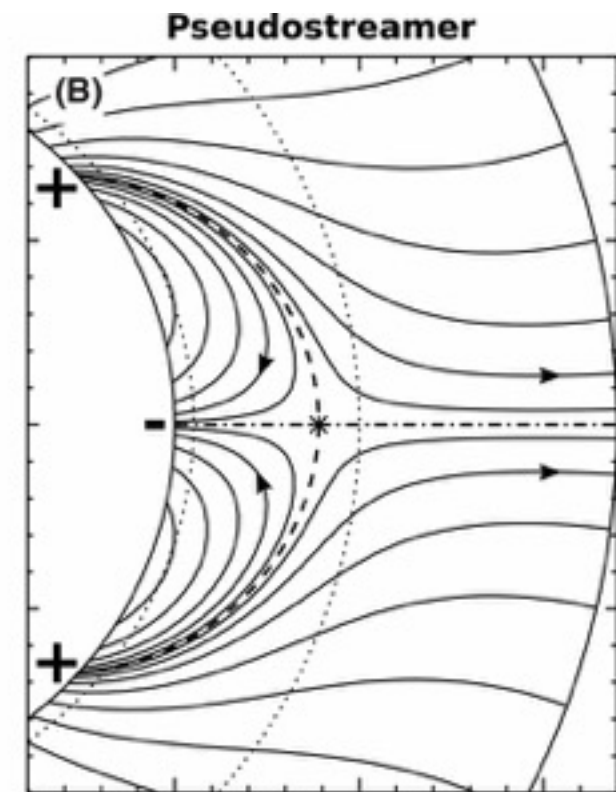
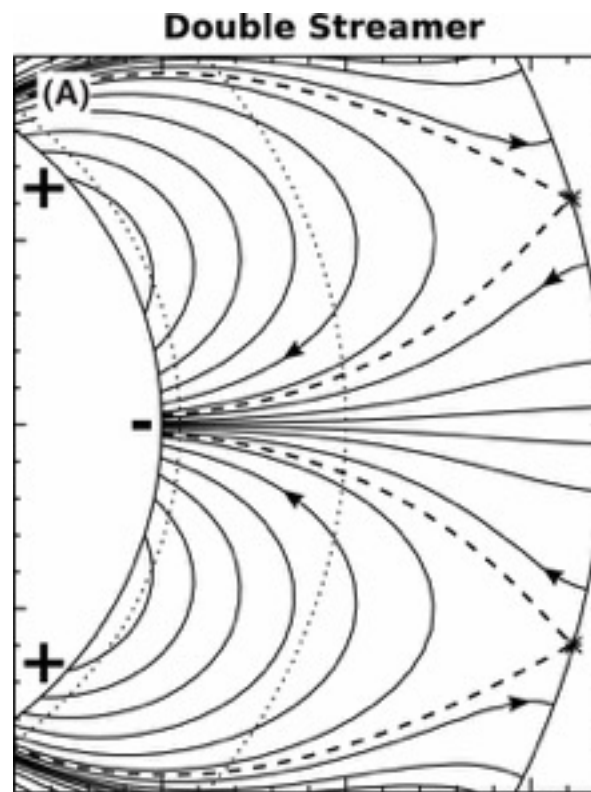


The structure
disappears
leaving a negative
polarity coronal
hole.

**The
photospheric
field reverses.**

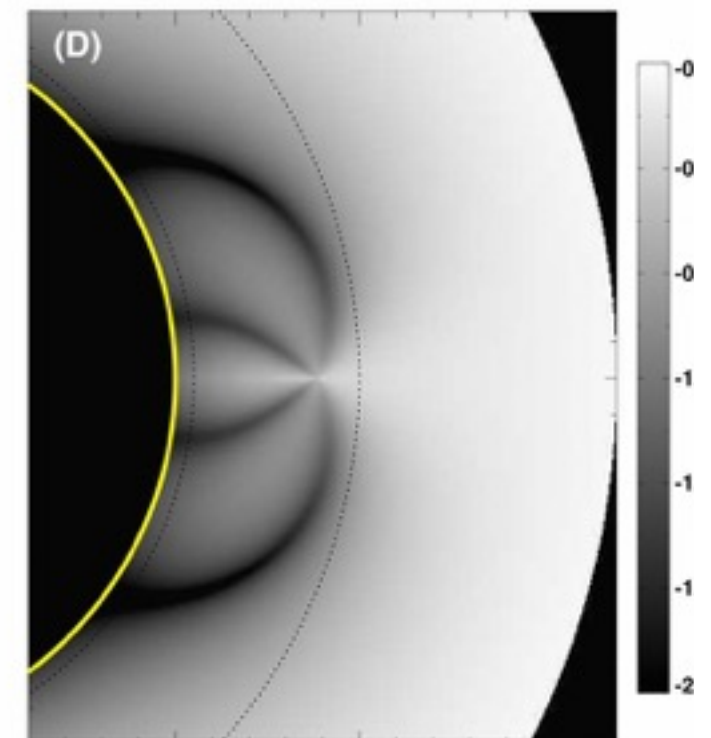
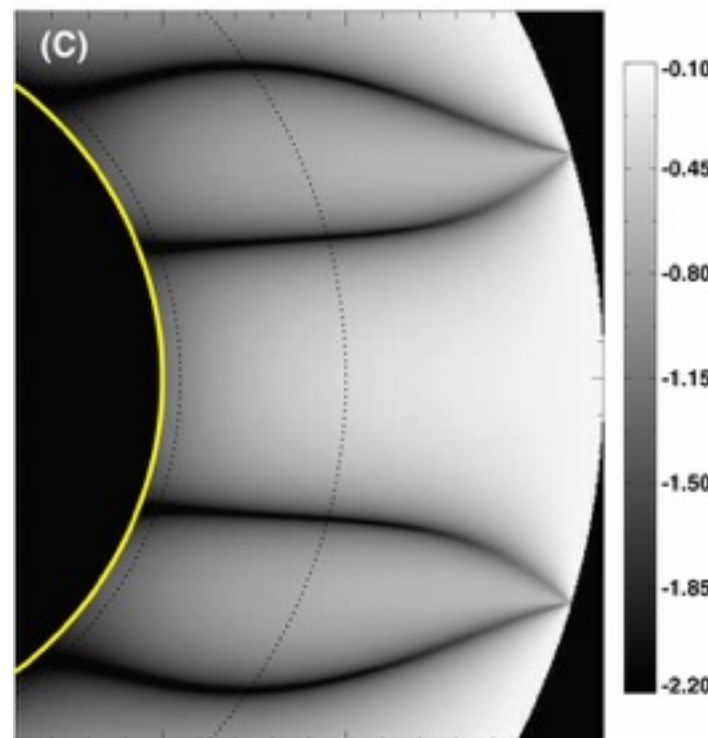
STREAMER TO PSEUDOSTREAMER TOPOLOGY CHANGE

Analytical model

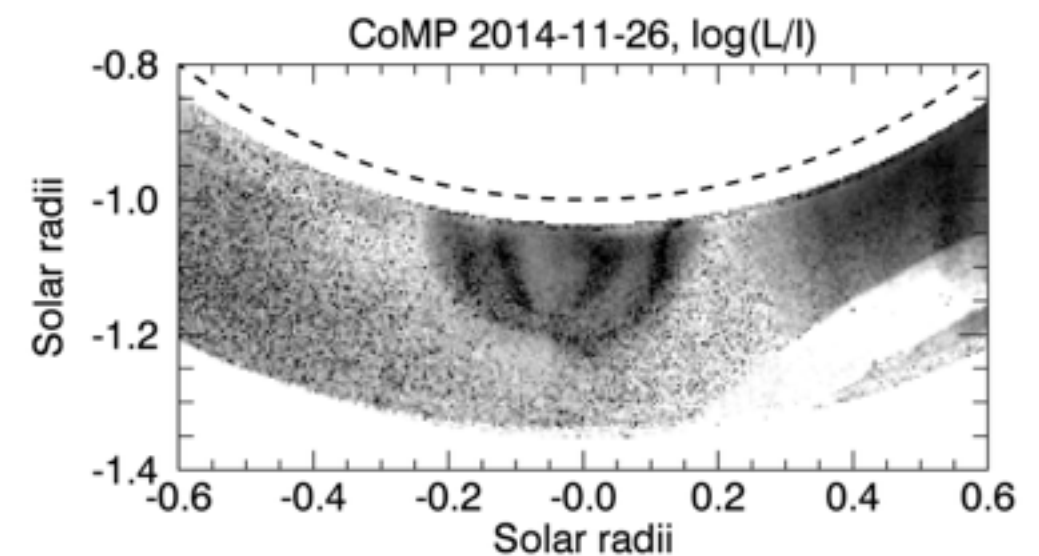
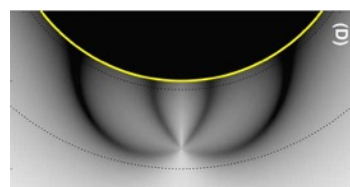
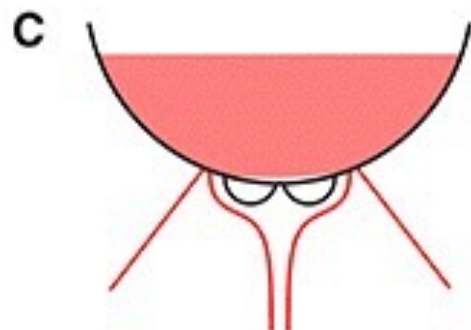
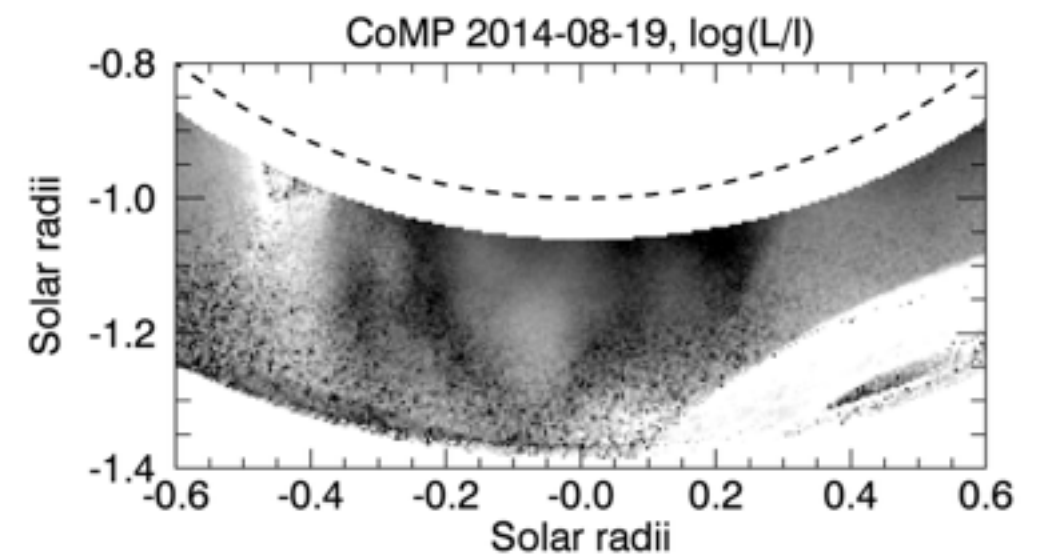
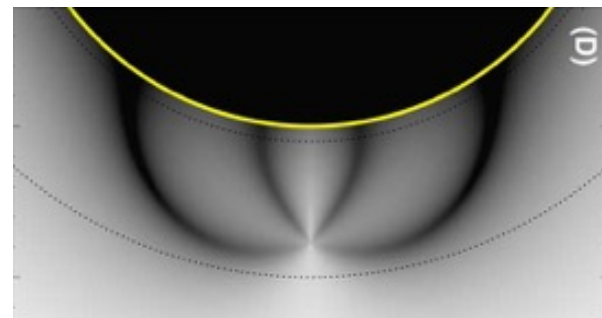
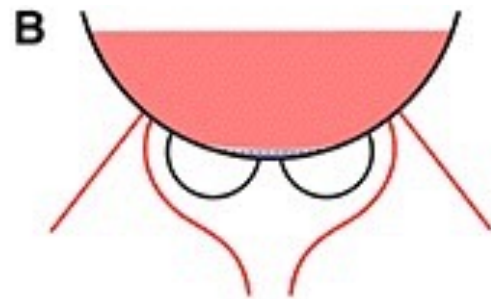
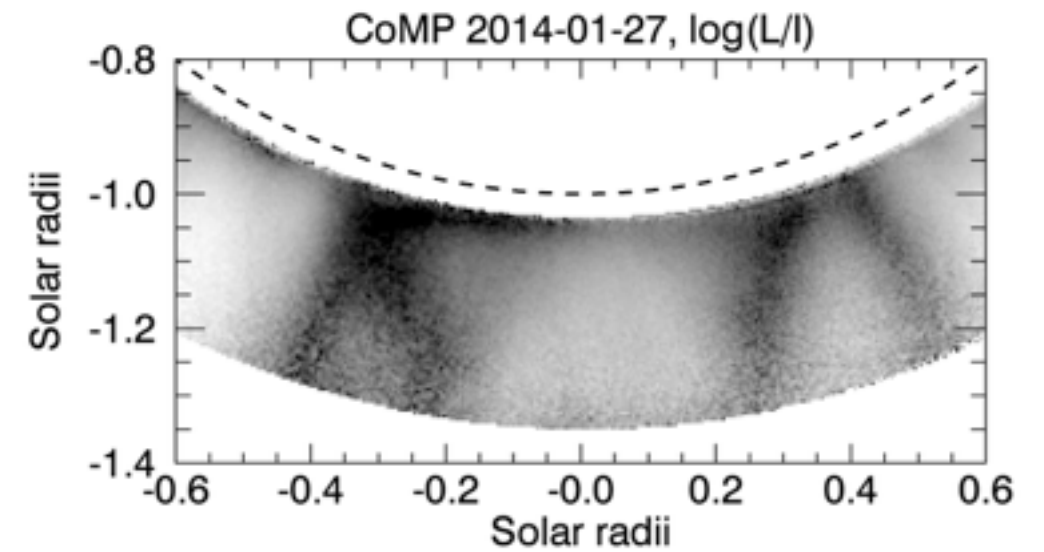
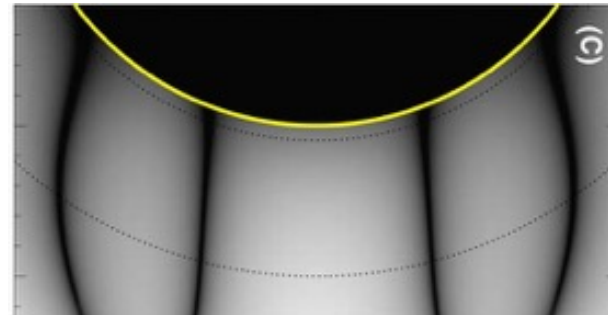
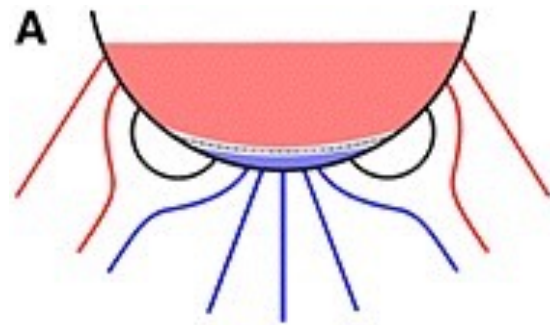


**Modeled
coronal polarization**

$$\frac{L}{I} = \frac{\sqrt{Q^2 + U^2}}{I}$$

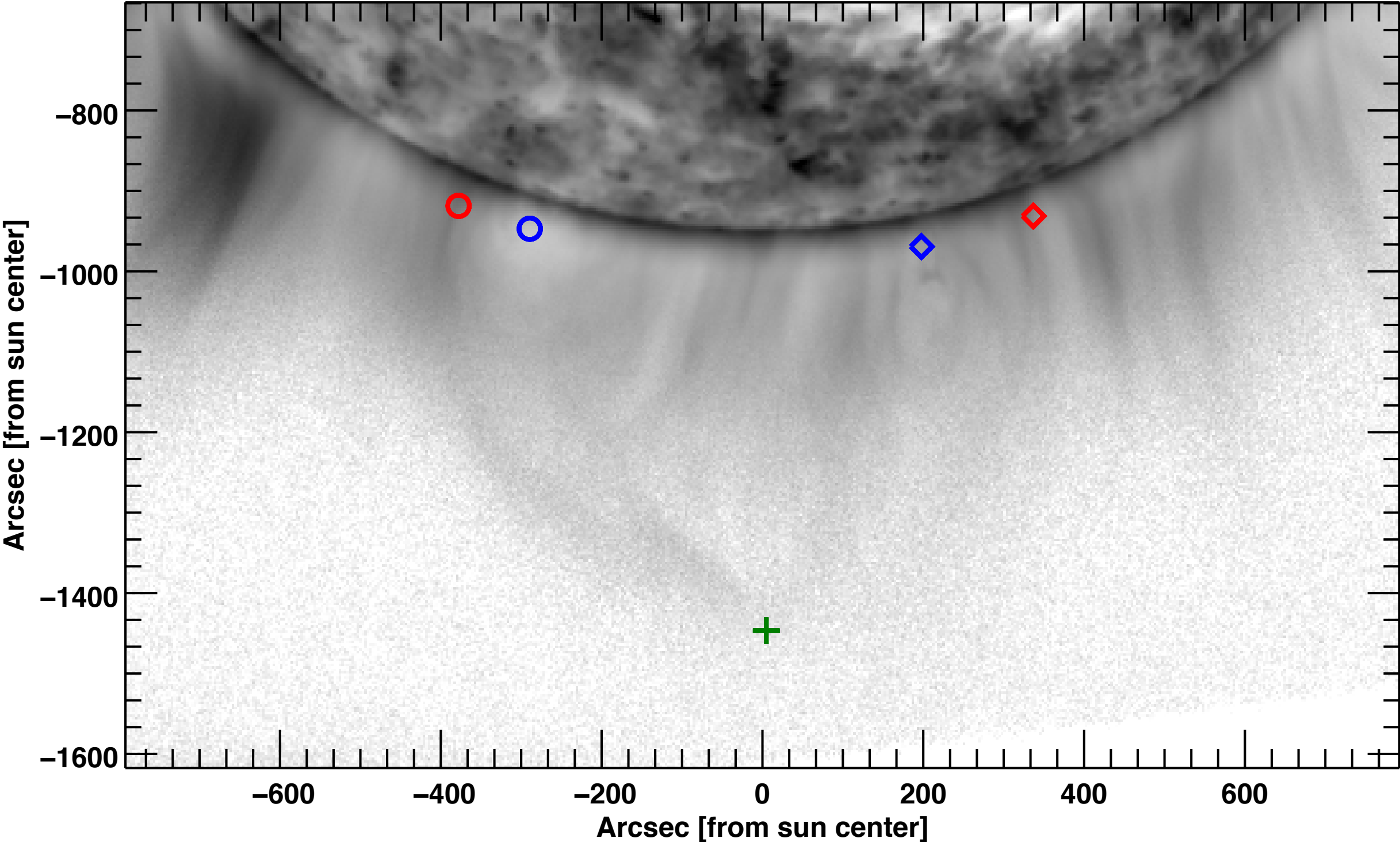


STREAMER TO PSEUDOSTREAMER TOPOLOGY CHANGE



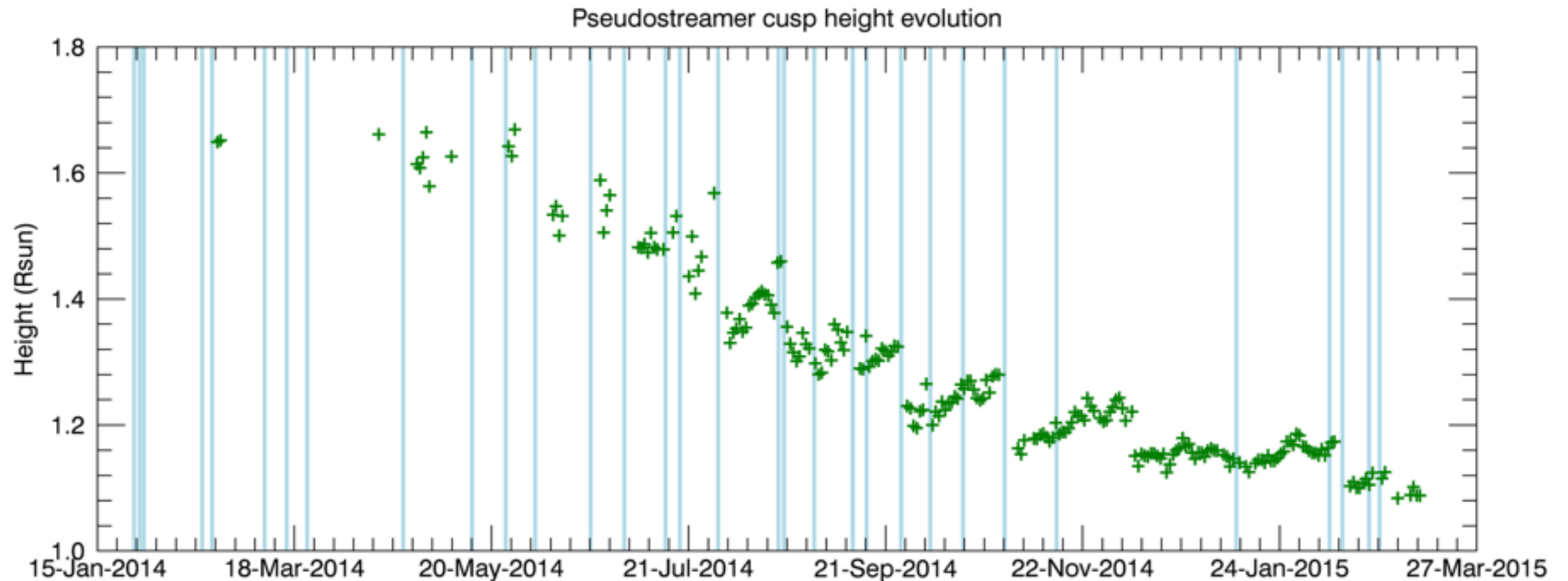
TRACING THE CORONAL STRUCTURE EVOLUTION

2014-06-12T01:11:22 SWAP 17.4 nm (inverted colortable)



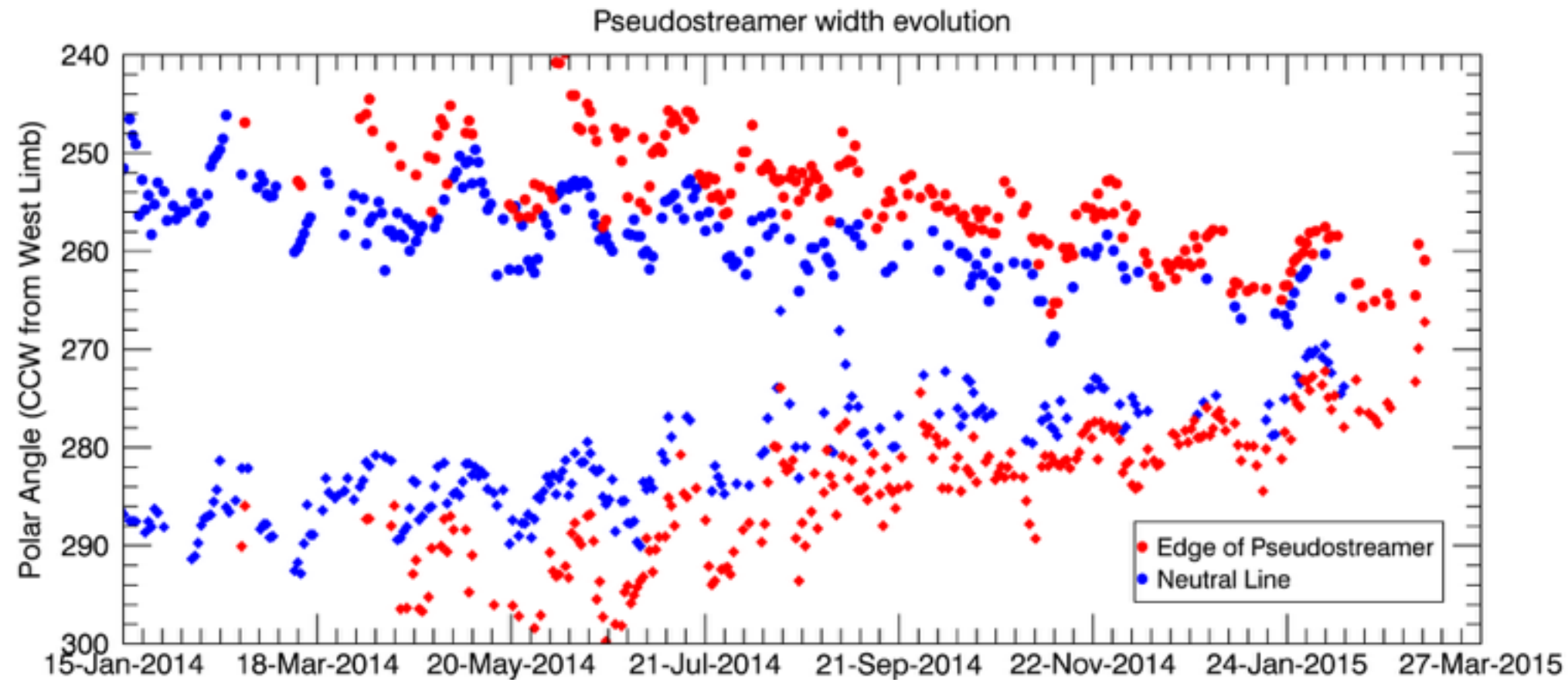
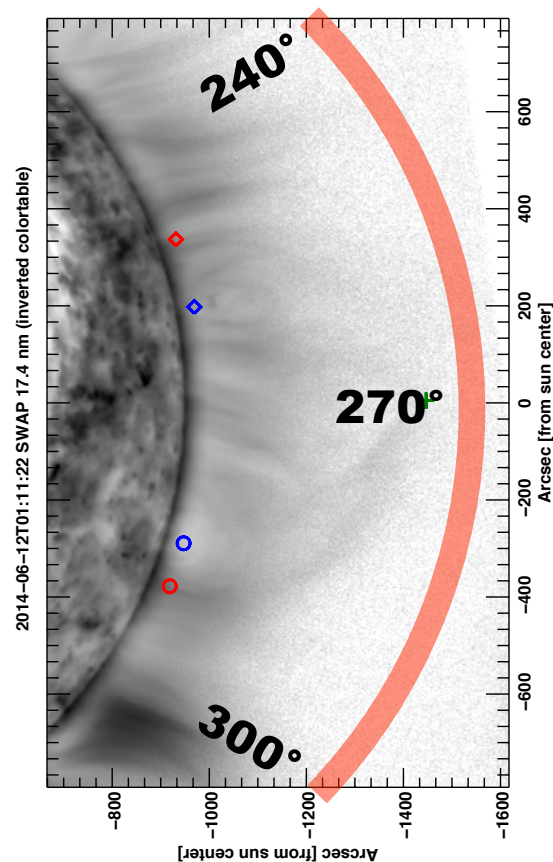
STRUCTURE EVOLUTION – HEIGHT

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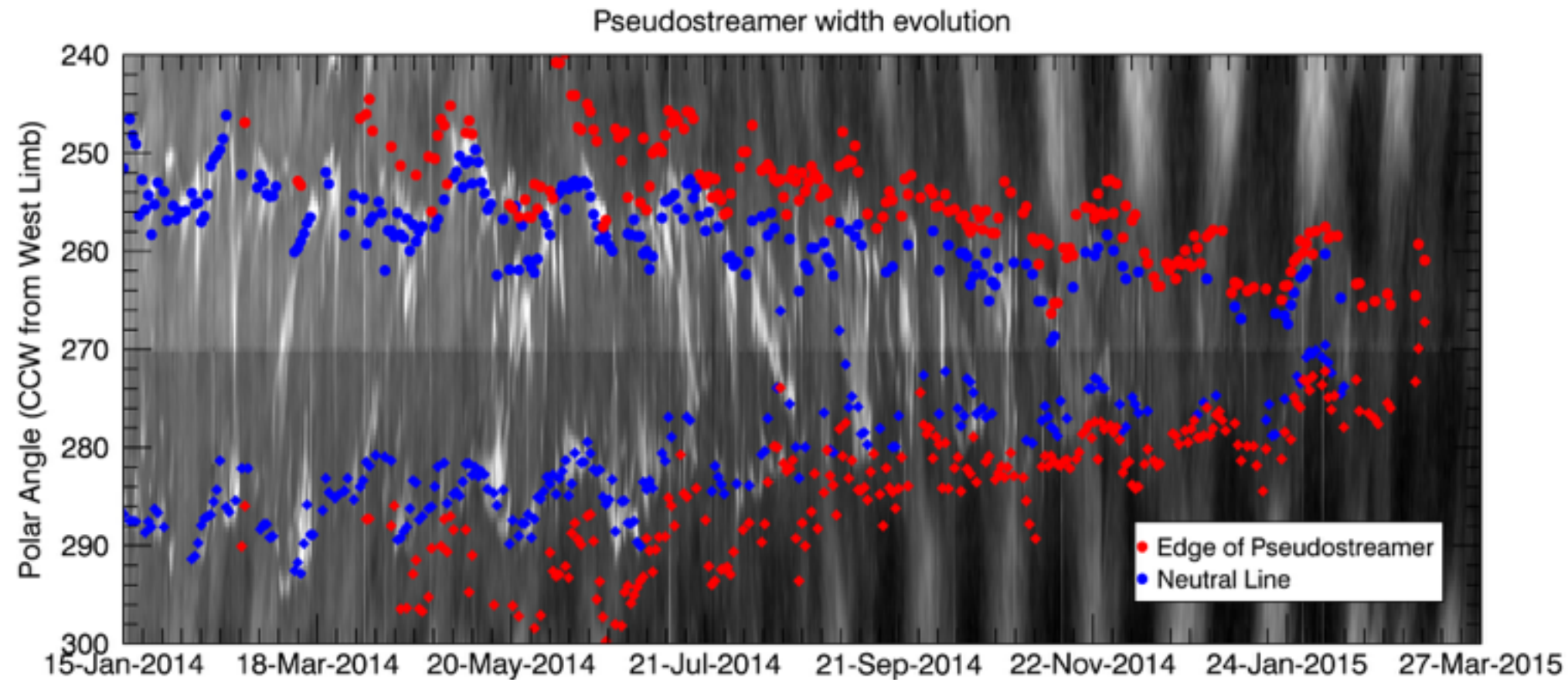
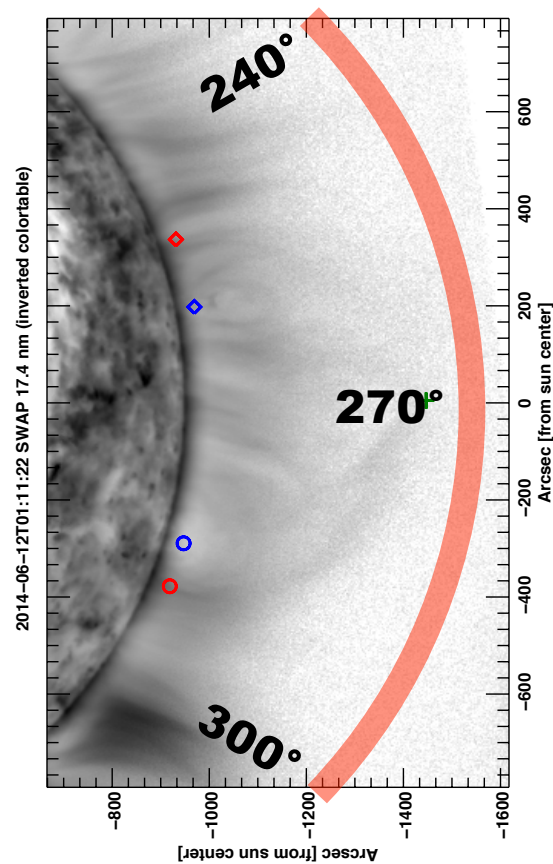
- The pseudostreamer shrinks over the course of the year.
- Eruptions are common, after which the structure reforms.

STRUCTURE EVOLUTION – WIDTH



- Pseudostreamer appears in March 2014 and shrinks in width over time.
- The center of the neutral line is ~ 5 degrees from the rotational axis.

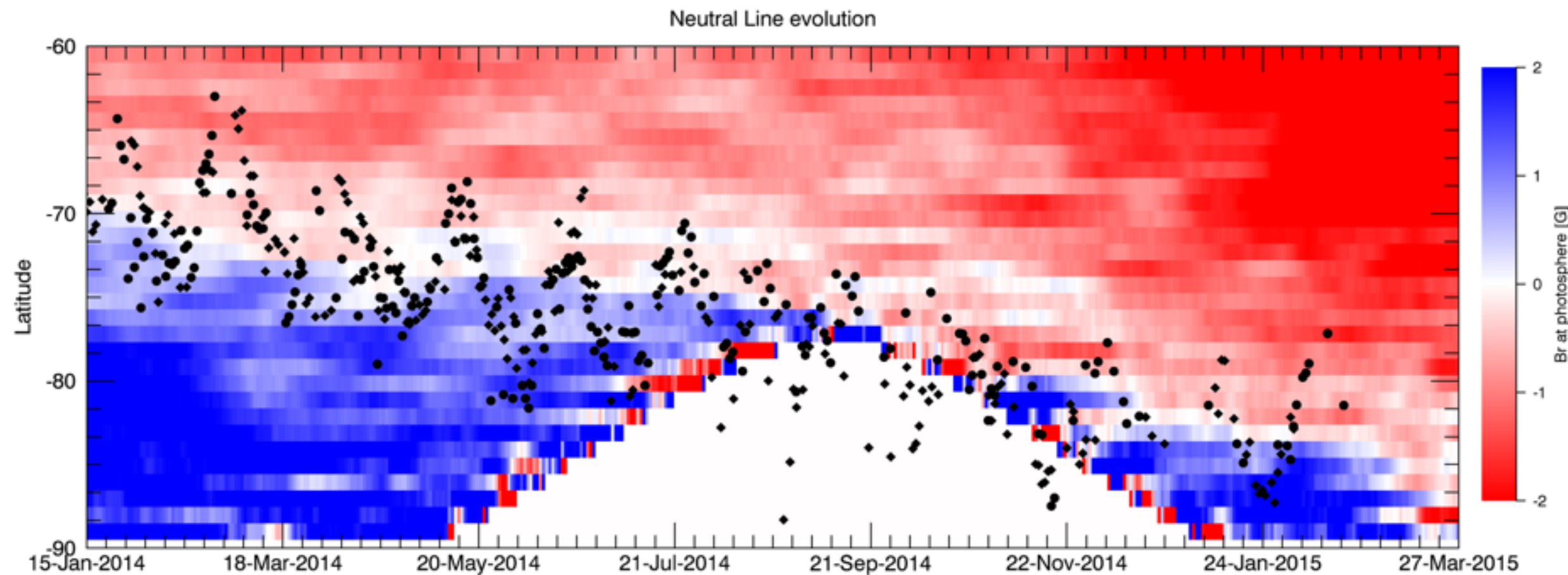
STRUCTURE EVOLUTION – WIDTH



AIA 304 background data from Karna et al 2015, DOI:10.1088/0004-637X/810/2/124

- Pseudostreamer appears in March 2014 and shrinks in width over time.
- The center of the neutral line is ~ 5 degrees from the rotational axis.

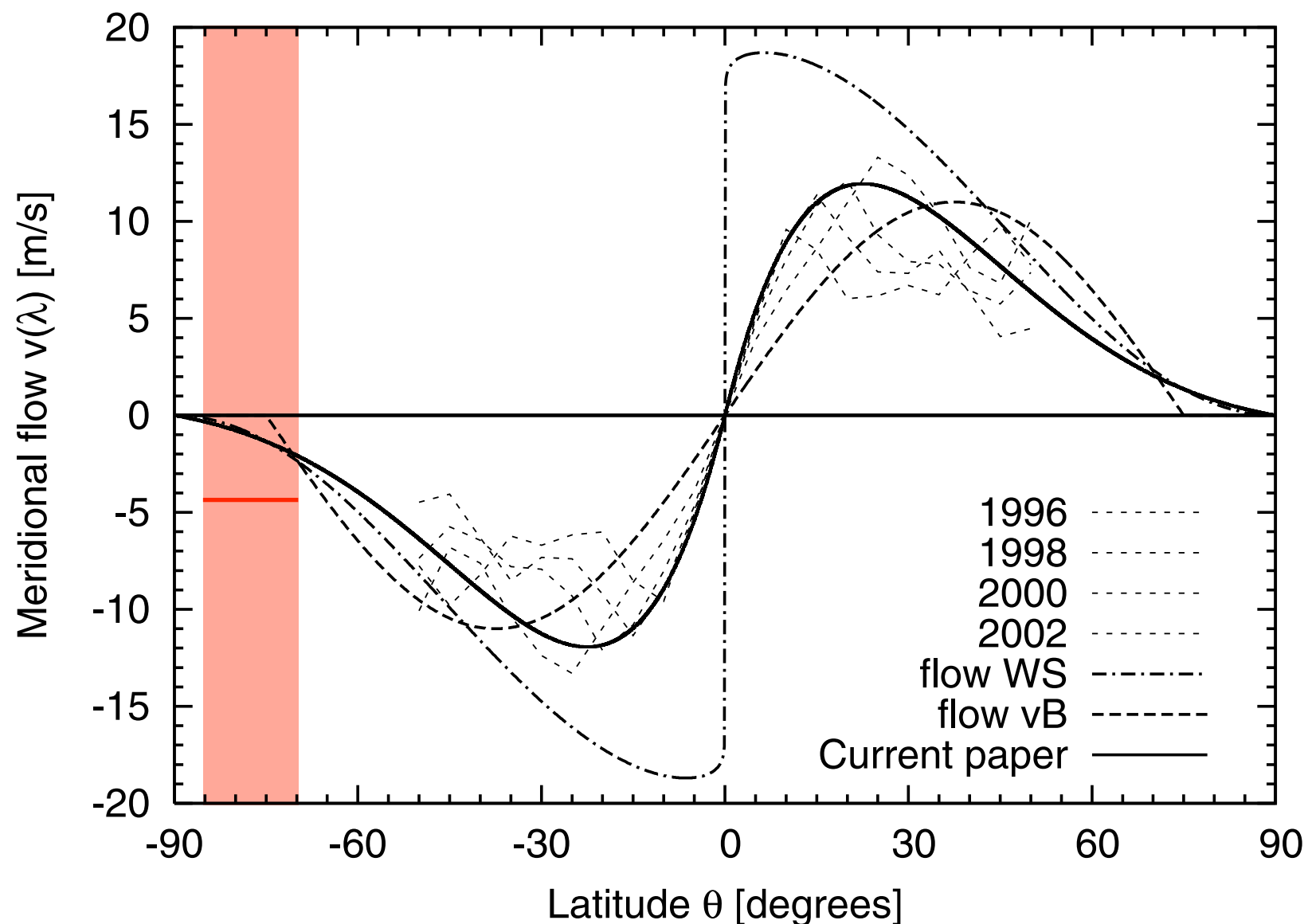
COMPARISON TO PHOTOSPHERE MEASUREMENTS



- The neutral line tracks well with the magnetogram data.
- Neutral line moves poleward at ~ 4.5 m/s over the course of a year.

NEUTRAL LINE MOVEMENT

- Measured poleward speed of ~ 4.5 m/s.
- Consistent with meridional flow speeds at high latitudes.
- Combination of meridional flow and diffusion (~ 600 km²/s).



CONCLUSIONS

- The south pole had a simple axisymmetric field reversal.
- The coronal field structure can be to trace the field reversal.
- The *corona and heliosphere* reversed polarity a year before the *photosphere*.

